

CLAIMS

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1. An indicium for placement on a workpiece for use in determining
2 whether the workpiece is valid, comprising:
3 a set of one or more markings corresponding to at least one of a signature from
4 a certifying authority (CA) and a string, said signature being based at least in part upon
5 said string wherein, if said workpiece is valid, said string is based upon, at least in part,
6 intrinsic physical characteristics of at least one portion of said workpiece, said physical
7 characteristics including one or more images of surface topographical appearance of
8 said at least one portion of said workpiece resulting when the at least one portion of
9 said workpiece is illuminated with electromagnetic radiation from different illumina-
10 tion positions relative to said at least one portion.

1 2. An indicium according to claim 1, wherein said one or more markings
2 comprise at least one of the following on said workpiece: a barcode, a sequence of dig-
3 its, and a spread-spectrum marking.

1 3. An indicium according to claim 1, wherein said workpiece comprises a
2 postal mailpiece.

1 4. An indicium according to claim 1, wherein said workpiece comprises a
2 postal mailpiece, and said string is also representative of a postage value associated
3 with said mailpiece, if said workpiece is valid.

1 5. An indicium according to claim 4, wherein said indicium is imprinted on
2 said mailpiece by an apparatus, and said string also identifies the apparatus, if said
3 workpiece is valid.

1 6. An indicium according to claim 5, wherein said string is based upon re-
2 spective numerical values representative of: one or more hash values representative of
3 said characteristics, said postage value, and an identification value identifying said ap-
4 paratus.

1 7. An indicium according to claim 1, wherein the different positions are at
2 respective different oblique angles, and an identical azimuthal angle, relative to the at
3 least one portion of the workpiece.

1 8. An indicium according to claim 1, wherein the different positions are at
2 respective different azimuthal angles, and an identical oblique angle, relative to the at
3 least one portion of the workpiece.

1 9. An indicium according to claim 1, wherein a portion of the radiation is
2 reflected from the at least one portion at an angle that is normal to a surface of the at
3 least one portion, and the one or more images are generated from said portion of the
4 radiation.

1 10. An indicium according to claim 1, wherein the radiation comprises co-
2 herent light.

1 11. An indicium according to claim 1, wherein the at least one portion com-
2 prises a plurality of portions of the workpiece.

1 12. An indicium according to claim 1, wherein said string is based upon, at
2 least in part, a concatenation of a plurality of numerical hash values derived from said
3 one or more images.

1 13. An indicium according to claim 1, wherein said string is based upon, at
2 least in part, differences between the one or more images.

1 14. Apparatus for use in generating a string for use in determining whether a
2 workpiece is valid, comprising:
3 an electromagnetic radiation source for illuminating at least one portion of the
4 workpiece with electromagnetic radiation from different illumination positions relative
5 to said at least one portion;
6 an imaging device for generating one or more images of surface topographical
7 appearance of said at least one portion when the at least one portion is illuminated with
8 the radiation by the source at the different illumination positions; and
9 a string generator that generates the string based upon, at least in part, the one or
10 more images.

1 15. Apparatus according to claim 14, further comprising a mechanism that
2 marks the workpiece with a set of one or more markings corresponding to at least one

3 of a signature from a certifying authority (CA) and the string, the signature being based
4 upon the string and a cryptographic key of the CA.

1 16. Apparatus according to claim 15, wherein said one or more markings
2 comprise at least one of the following on said workpiece: a barcode, a sequence of dig-
3 its, and a spread-spectrum marking.

1 17. Apparatus according to claim 15, wherein said workpiece comprises a
2 postal mailpiece.

1 18. Apparatus according to claim 15, wherein said workpiece comprises
2 postal mailpiece, and said string is also representative of a postage value associated
3 with said mailpiece, if said workpiece is valid.

1 19. Apparatus according to claim 18, wherein said one or more markings are
2 imprinted on said mailpiece, and said string is also identifies the apparatus, if said
3 workpiece is valid.

1 20. Apparatus according to claim 19, wherein said string is based upon re-
2 spective numerical values representative of: one or more hash values representative of
3 said appearance, said postage value, and an identification value identifying said appa-
4 ratus.

1 21. Apparatus according to claim 14, wherein the different positions are at
2 respective different oblique angles, and an identical azimuthal angle, relative to the at
3 least one portion of the workpiece.

1 22. Apparatus according to claim 14, wherein the different positions are at
2 respective different azimuthal angles, and an identical oblique angle, relative to the at
3 least one portion of the workpiece.

1 23. Apparatus according to claim 14, wherein a portion of the radiation is
2 reflected from the at least one portion at an angle that is normal to a surface of the at
3 least one portion, and the one or more images are generated from said portion of the
4 radiation.

1 24. Apparatus according to claim 14, wherein the radiation comprises co-
2 herent light.

1 25. Apparatus according to claim 14, wherein the at least one portion com-
2 prises a plurality of portions of the workpiece.

1 26. Apparatus according to claim 14, wherein said string is based upon, at
2 least in part, a concatenation of a plurality of numerical hash values derived from said
3 one or more images.

1 27. Apparatus according to claim 14, wherein said string is based upon, at
2 least in part, differences between the one or more images.

1 28. Method for generating a string for use in determining whether a work-
2 piece is valid, comprising:

3 illuminating at least one portion of the workpiece with electromagnetic radiation
4 from different illumination positions relative to said at least one portion;

5 generating one or more images of surface topographical appearance of said at
6 least one portion when the at least one portion is illuminated with the radiation at the
7 different illumination positions; and

8 generating the string based upon, at least in part, the one or more images.

1 29. Method according to claim 28, further comprising marking the work-
2 piece with a set of one or more markings corresponding to at least one of a signature
3 from a certifying authority (CA) and the string, the signature being based upon the
4 string and a cryptographic key of the CA.

1 30. Method according to claim 29, wherein said one or more markings com-
2 prise at least one of the following on said workpiece: a barcode, a sequence of digits,
3 and a spread-spectrum marking.

1 31. Method according to claim 28, wherein said workpiece comprises a
2 postal mailpiece.

1 32. Method according to claim 29, wherein said workpiece comprises a
2 postal mailpiece, and said string is also representative of a postage value associated
3 with said mailpiece, if said workpiece is valid.

1 33. Method according to claim 32, wherein said one or more markings are
2 imprinted on said mailpiece by an apparatus, and said string also identifies the appara-
3 tus, if said workpiece is valid.

1 34. Method according to claim 33, wherein said string is based upon respec-
2 tive numerical values representative of: one or more hash values representative of said
3 appearance, said postage value, and an identification value identifying said apparatus.

1 35. Method according to claim 28, wherein the different positions are at dif-
2 ferent oblique angles, and an identical azimuthal angle, relative to the at least one por-
3 tion of the workpiece.

1 36. Method according to claim 28, wherein the different positions are at re-
2 spective different azimuthal angles, and an identical oblique angle, relative to the at
3 least one portion of the workpiece.

1 37. Method according to claim 28, wherein a portion of the radiation is re-
2 flected from the at least one portion at an angle that is normal to a surface of the at least
3 one portion, and the one or more images are generated from said portion of the radia-
4 tion.

1 38. Method according to claim 28, wherein the radiation comprises coherent
2 light.

1 39. Method according to claim 28, wherein the at least one portion com-
2 prises a plurality of portions of the workpiece.

1 40. Method according to claim 28, wherein said string is based upon, at least
2 in part, a concatenation of a plurality of numerical hash values derived from said one or
3 more images.

1 41. Method according to claim 28, wherein said string is based upon, at least
2 in part, differences between the one or more images.

1 42. Computer-readable memory comprising computer-executable program
2 instructions for use in generating a string for use in determining whether a workpiece is
3 valid, the instructions when executed causing:

4 illumination of at least one portion of the workpiece with electromagnetic ra-
5 diation from different illumination positions relative to said at least one portion;

6 generation of one or more images of surface topographical appearance of said at
7 least one portion when the at least one portion is illuminated with the radiation at the
8 different illumination positions; and

9 generation of the string based upon, at least in part, the one or more images.

1 43. Memory according to claim 42, wherein the instructions when executed
2 also cause marking of the workpiece with a set of one or more markings corresponding
3 to at least one of a signature from a certifying authority (CA) and the string, the signa-
4 ture being based upon the string and a cryptographic key of the CA.

1 44. Memory according to claim 43, wherein said one or more markings
2 comprise at least one of the following on said workpiece: a barcode, a sequence of dig-
3 its, and a spread-spectrum marking.

1 45. Memory according to claim 42, wherein said workpiece comprises a
2 postal mailpiece.

1 46. Memory according to claim 43, wherein said workpiece comprises a
2 postal mailpiece, and said string is also representative of a postage value associated
3 with said mailpiece, if said workpiece is valid.

1 47. Memory according to claim 46, wherein said one or more markings are
2 imprinted on said mailpiece by an apparatus, and said string also identifies the appa-
3 tus, if said workpiece is valid.

1 48. Memory according to claim 47, wherein said string is based upon re-
2 spective numerical values representative of: one or more hash values representative of
3 said appearance, said postage value, and an identification value identifying said appa-
4 ratus.

1 49. Memory according to claim 42, wherein the different positions are at re-
2 spective different oblique angles, and an identical azimuthal angle, relative to the at
3 least one portion of the workpiece.

1 50. Memory according to claim 42, wherein the different positions are at re-
2 spective different azimuthal angles, and an identical oblique angle, relative to the at
3 least one portion of the workpiece.

1 51. Memory according to claim 42, wherein a portion of the radiation is re-
2 flected from the at least one portion at an angle that is normal to a surface of the at least
3 one portion, and the one or more images are generated from said portion of the radia-
4 tion.

1 52. Memory according to claim 42, wherein the radiation comprises coher-
2 ent light.

1 53. Memory according to claim 42, wherein the at least one portion com-
2 prises a plurality of portions of the workpiece.

1 54. Memory according to claim 42, wherein said string is based upon, at
2 least in part, a concatenation of a plurality of numerical hash values derived from said
3 images.

1 55. Memory according to claim 42, wherein said string is based upon, at
2 least in part, differences between the images.

1 56. An indicium according to claim 1, wherein the at least one portion is il-
2 luminated with the radiation simultaneously from the different illumination positions.

1 57. An indicium according to claim 1, wherein the one or more images
2 comprise a plurality of respective images of surface topographical appearances of the at
3 least one portion resulting when the at least one portion is illuminated with the radiation
4 from respective illumination positions relative to the at least one portion.

1 58. An indicium according to claim 1, wherein the string is based upon, at
2 least in part, a numerical hash value derived from the one or more images, the value
3 being generated by a process that includes extracting from the one or more images a
4 first image portion scaling the first image portion to generate a scaled image portion,
5 averaging pixel value of the scaled image portion to generate a first filtered image, ex-
6 tracting from the first filtered image a second image portion, averaging pixel values of
7 the second image portion to generate a second filtered image, and subtracting corre-
8 sponding pixel value of the second filtered image from the second image portion to
9 generate a third filtered image.

1 59. Apparatus according to claim 14, wherein the at least one portion is il-
2 luminated with the radiation simultaneously from the different illumination positions.

1 60. Apparatus according to claim 14, wherein the images of surface topog-
2 raphical appearances of the at least one portion resulting when the at least one portion
3 is illuminated with the radiation from respective illumination positions relative to the at
4 least one portion.

1 61. Apparatus according to claim 14, wherein the string is based upon, at
2 least in part, a numerical hash value derived from the one or more images, the value
3 being generated by a process that includes extracting from the one or more images a
4 first image portion, scaling the first image portion to generate a scaled image portion,
5 averaging pixel values of the scaled image portion to generate a first filtered image,
6 extracting from the first filtered image a second image portion, averaging pixel values
7 of the second image portion to generate a second filtered image, and subtracting corre-
8 sponding pixel values of the second filtered image from the second image portion to
9 generate a third filtered image.

1 62. Method according to claim 28, wherein the at least one portion is illumi-
2 nated with the radiation simultaneously from the different illumination positions.

1 63. Method according to claim 28, wherein the one or more images com-
2 prise a plurality of respective images of surface topographical appearances of the at
3 least one portion resulting when the at least one portion is illuminated with the radiation
4 from respective illumination positions relative to the at least one portion.

1 64. Method according to claim 28, wherein the string is based upon, at least
2 in part, a numerical hash value derived from the one or more images, the value being
3 generated by a process that includes extracting from the one or more images a first im-
4 age portion, scaling the first image portion to generate a scaled image portion, averag-
5 ing pixel values of the scaled image portion to generate a first filtered image, extracting
6 from the first filtered image a second image portion, averaging pixel values of the sec-
7 ond image portion to generate a second filtered image, and subtracting corresponding
8 pixel values of the second filtered image from the second image portion to generate a
9 third filtered image.

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1 65. Memory according to claim 42, wherein at least one portion is illumi-
2 nated with the radiation simultaneously from the different illumination positions.

1 66. Memory according to claim 42, wherein the one or more images com-
2 prise a plurality of respective images of surface topographical appearances of the at
3 least one portion resulting when the at least one portion is illuminated with the radiation
4 from respective illumination positions relative to the at least one portion.

1 67. Memory according to claim 42, wherein the string is based upon, at least
2 in part, a numerical hash value derived from the one or more images, the value being
3 generated by a process that includes extracting from the one or more images a first im-
4 age portion, scaling the first image portion to generate a scaled image portion, averag-
5 ing pixel values of the scaled image portion to generate a first filtered image, extracting
6 from the first filtered image a second image portion, averaging pixel values of the second

7 image portion to generate a second filtered image, and subtracting corresponding pixel
8 values of the second filtered image from the second image portion to generate a third
9 filtered image.

1 68. An indicium according to claim 1, wherein the one or more images are
2 generated using one of a linear array of photosensing elements, a two-dimensional ar-
3 ray of photosensing elements and a single photosensing element.

1 69. Apparatus according to claim 14, wherein the imaging device comprises
2 one of a linear array of photosensing elements, a two-dimensional array of photo-
3 sensing elements and a single photosensing element.

1 70. Method according to claim 28, wherein the one or more images are gen-
2 erated using one of a linear array of photosensing elements, a two-dimensional array of
3 photosensing elements and a single photosensing element.

1 71. Memory according to claim 42, wherein the one or more images are
2 generated using one of a linear array of photosensing elements, a two-dimensional ar-
3 ray of photosensing elements and a single photosensing element.

1 72. An indicium according to claim 1, wherein the indicium uniquely identi-
2 fies the workpiece.

1 73. Apparatus according to claim 14, wherein the string uniquely identifies
2 the workpiece.

1 74. Method according to claim 28, wherein the string uniquely identifies the
2 workpiece.

1 75. Memory according to claim 42, wherein the string uniquely identifies
2 the workpiece.

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1 76. An indicium according to claim 1, wherein the string is based, at least in
2 part, upon an averaging of portions of the one or more images.

1 77. An inidicum according to claim 1, wherein the string is based, at least in
2 part, upon a calculation of principal components of the one or more images.

1 78. Apparatus according to claim 14, wherein the string is based, at least in
2 part, upon an averaging of portions of the one or more images.

1 79. Apparatus according to claim 14, wherein the string is based, at least in
2 part, upon a calculation of principal components of the one or more images.

1 80. Method according to claim 28, wherein the string is based, at least in
2 part, upon an averaging of portions of the one or more images.

81. Method according to claim 28, wherein the string is based, at least in part, upon a calculation of principal components of the one or more images.

1 82. Memory according to claim 42, wherein the string is based, at least in
2 part, upon an averaging of portions of the one or more images.

1 83. Memory according to claim 42, wherein the string is based, at least in
2 part, upon a calculation of principal components of the one or more images.